HDR IMAGES FOR GLARE EVALUATION

COMPARISON BETWEEN DSLR CAMERAS, AN ABSOLUTE CALIBRATED LUMINANCE CAMERA AND A SPOT LUMINANCE METER

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ABSTRACT

User calibrated digital single-lens reflex (DSLR) cameras, utilizing an automated image calibration algorithm, are being used for glare evaluations as affordable alternatives to high-end luminance cameras calibrated by manufacturers. This study investigates the accuracy of luminance maps derived from HDR images captured with auto-calibrated DSLR cameras. More specifically, to compare the luminance values obtained with an auto-calibrated DSLR camera with a commercially available camera (that benefited from an absolute calibration) and a handheld luminance meter, considered as the reference. It was found that there are only small differences when luminance values estimated with auto-calibrated DSLR cameras are compared with those obtained for the commercially calibrated camera for low to mid-range luminance values (50 – 5000 cd/m^2). However, for higher luminance values (→5000 cd/m^2), HDR images from the auto-calibrated camera show differences of up to 20 %, which could be problematic for glare investigations. More studies specifically focusing on high luminances are needed to determine more conclusively whether certain limitations should apply to the use of automatically calibrated DSLR cameras for glare evaluations.

Methodology

Two DSLR cameras were calibrated for HDR imaging with an automatic calibration algorithm (hdrgen); including image projection and vignetting correction. Luminance values obtained with the DSLR cameras in different light scenarios were compared with measurements from an absolute manufacture calibrated camera (LMK) and a luminance meter (Konica). Illuminance was measured at the cameras' position (LMT).

Camera calibration

The two DSLR cameras were set up for HDR imaging with hdrgen by following these steps:

Creating a response curve

Response curves were created in a daylit room containing furniture, an outside view and large white, grey and black areas.

Reprojecting the images

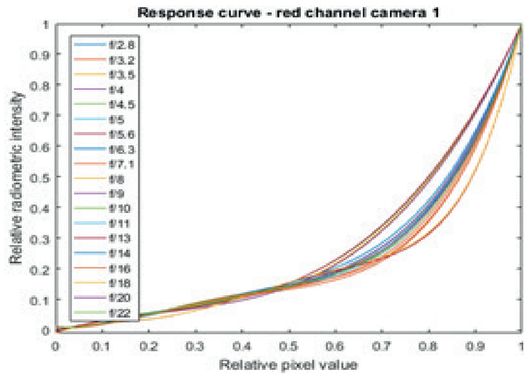
Reprojecting the images from equisolid to equidistant was done with the fiseye_corr.cal file script.

Vignetting correcting

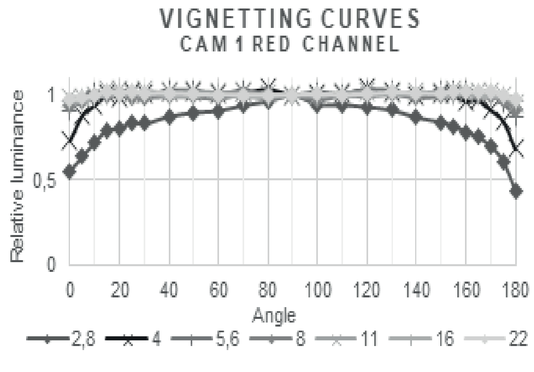
Vignetting measurements were done by recording the light dropoff, as the camera/lens system was rotated around an artificial light source.

Luminance adjustment

Luminance adjustment was done by measuring a target in the scene with a luminance meter. The ratio between the measurement and the image was applied as an adjustment factor to all pixels in the image.



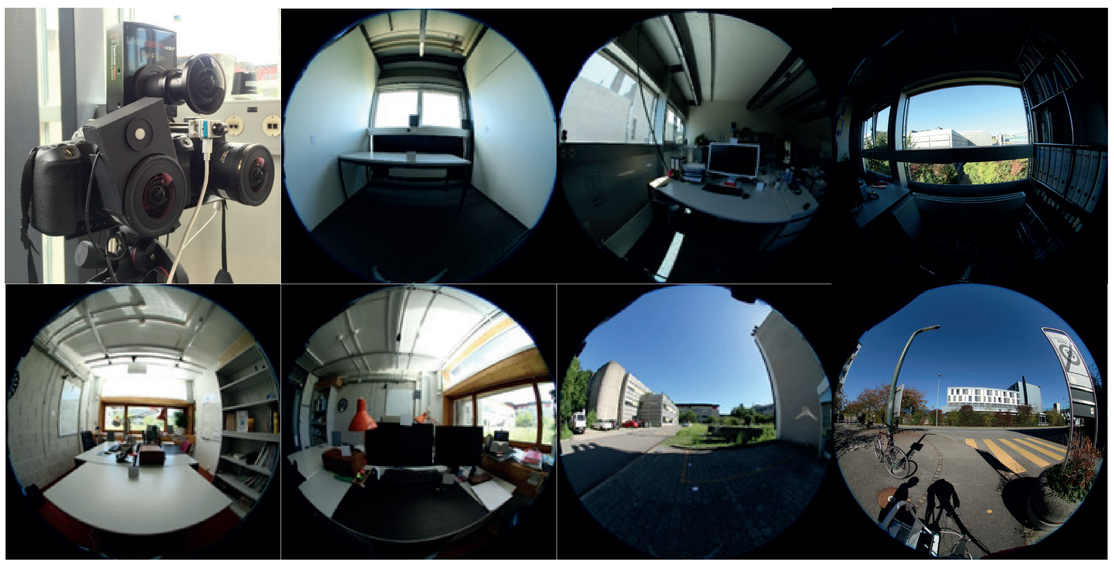
Red channel response curves for all apertures of camera 1.



Vignetting curves from camera 1.

Measurement setup

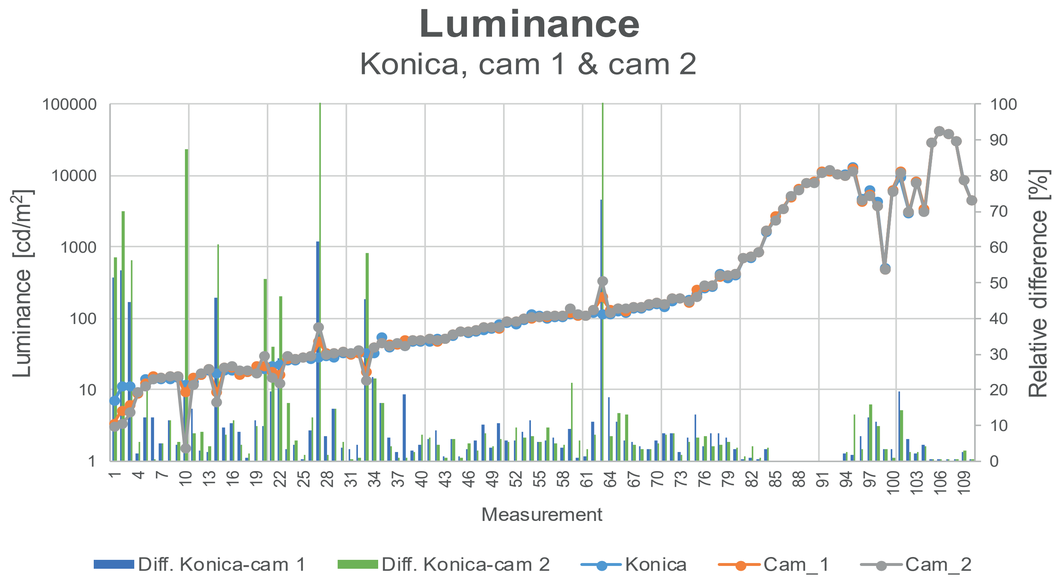
The instruments used were: two Canon DSLR cameras, a manufacturer absolute calibrated LMK 98-4 color camera from TechnoTeam., a Konica Minolta LS110 luminance meter and a LMT Pocket Lux illuminance sensor. Five different scenes with a total of 17 different light scenarios were shot. Targets were measured for luminance.



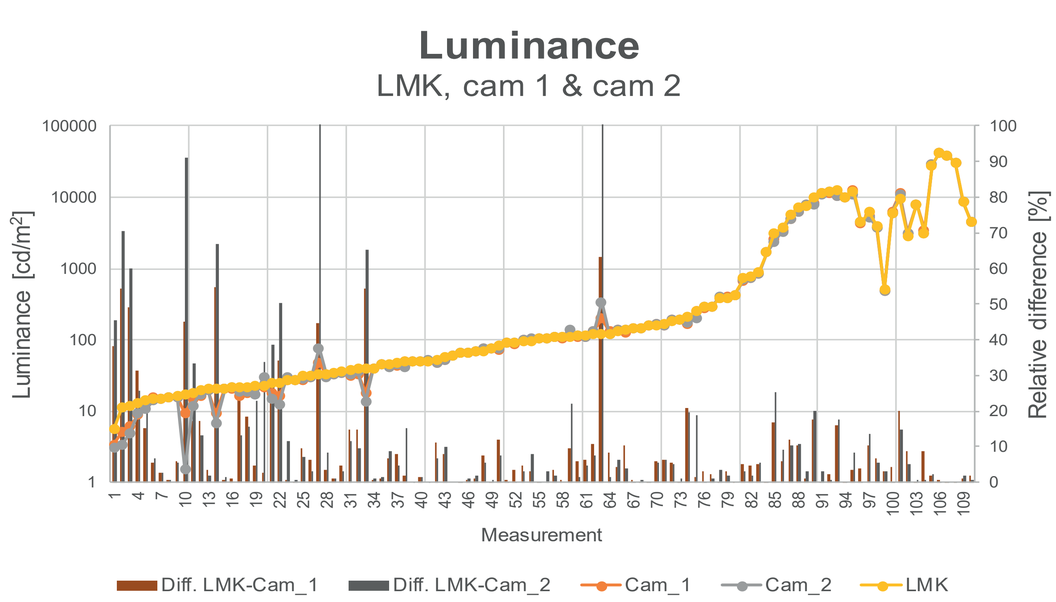
Instrument setup and the scenes.

Results

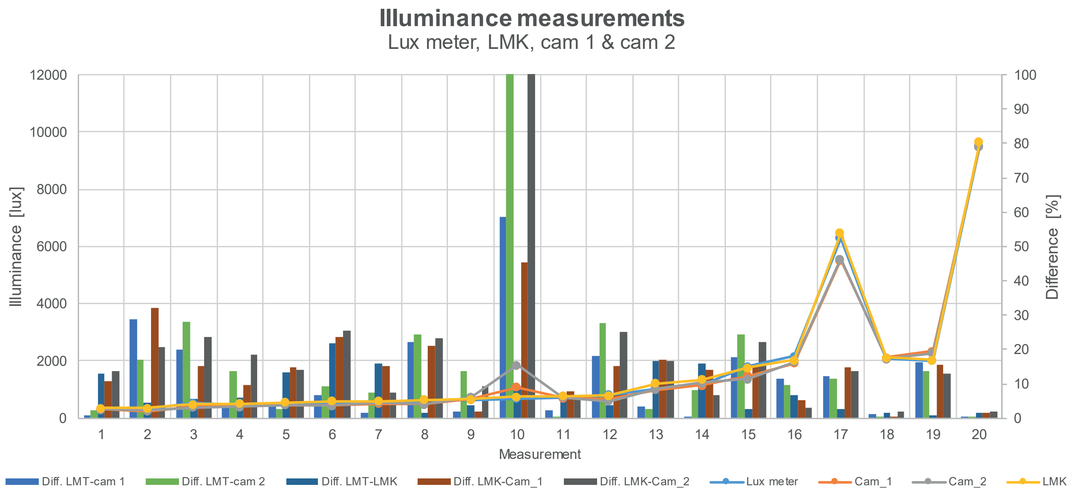
Comparisons between the DSLR cameras, the manufacture calibrated LMK camera and the Konica Minolta was done for several targets in the different scenes.



Luminance values measured with the Konica Minolta and DSLR cameras. The bars show percentage difference and follow the right-hand axis.



Luminance values measured with the LMK and DSLR cameras. The bars show percentage difference and follow the right-hand axis.



Illuminance values measured with lux meter and calculated from the cameras. Bars show percentage difference and follow the right axis.

Conclusion

- Small differences between DSLR cameras and LMK camera in low luminance range (50-5000 cd/m^2)
- Deviations of up to 20 % in higher luminances (→5000 cd/m^2)
- Systematic illuminance differences of 10 to 20 % between the DSLR' cameras and the LMK camera and LMT measurements

Differences in the higher luminance range could be a potential problem if DSLR cameras are intended for use in glare studies. More studies of bright scenes should be done to investigate the accuracy of DSLR cameras in high luminance scenarios. It also remains to investigate if and how DSLR cameras can resolve very high luminances – for example with the sun in the field of view - and unbalanced scenes. It is recommend that vertical illuminance and at least 2 luminance targets, in the high and low range, are measured in order to correct images when using user-calibrated DSLR cameras as luminance instruments.

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Peter is a PhD student at the Civil and Environmental Engineering (EDCE) doctoral program and he joined the LIPID Lab in July 2015. Peter is originally from Denmark where he received his B. Eng. in 2012 from the Engineering College of Aarhus and his M.Sc. Eng. in 2014 from Aarhus University.

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